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memorandum

DATE: September 11, 2001

REPLY TO ATTN OF: *Office* of Worker Protection Policy and Programs: Peter O'Connell:30 1-903-5641

SUBJECT TECHNICAL POSITION REGARDING ACCEPTABLE APPROACHES TO DEVELOPING AIR CONCENTRATION VALUES FOR SPECIAL TRITIUM COMPOUNDS

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Since May 1995, my office has provided several clarifications and technical positions regarding the Department of Energy's (DOE) expectations concerning implementing selected provisions of Title 10 of the Code of Federal Regulations, Part 835 (10 CFR 835), *Occupational Radiation Protection.* To assist field implementation of 10 CFR 835, we have developed, and are now distributing, the following Radiological Control Technical Position (RCTP) paper:

- Acceptable Approach for Developing Air Concentration Values for Controlling Exposures to Special Tritium Compounds

The attached technical position does not represent new policy or direction to the field. Rather, it provides clarification at the request of the field, Headquarters, and program offices to facilitate and promote the efficient and cost effective implementation of10CFR835.

This RCTP updates and replaces RCTP 99-02, *Acceptable Approach for Developing Air Concentration Values for Controlling Exposures to Tritiated Particulate Aerosols and Organically-Bound Tritium.*

Please ensure further distribution of the attached documents to the applicable radiation protection organizations at your facilities. The DOE Radiological Control Coordinating Committee has reviewed these technical positions. For additional information, please contact Mr. Peter O'Connell (Office of Worker Protection Policy and Programs) on 301-903-5641.

Steven V. Cary
Acting Assistant Secretary
Office of Environment, Safety and Health

Attachment

cc w/attachment:
See distribution list

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Department of Energy
Office of Worker Protection Policy and Programs
Radiological Control Technical Position
RCTP 2001 - 02

Acceptable Approach for Developing Air Concentration Values for Controlling Exposures to Special Tritium Compounds

Issue:

Title 10 Code of Federal Regulations, Part 835 (10 CFR 835), *Occupational Radiation Protection*, specifies occupational radiation protection requirements for Department of Energy (DOE) activities and includes provisions related to the monitoring and control of individual exposures to various airborne radionuclides. However, although appendix A of 10 CFR 835 specifies derived air concentration (DAC) values for elemental tritium and tritiated water vapor, it does not specify values for either tritiated particulate aerosols or organically-bound tritium (OBT). Accordingly, in 1999, the Office of Worker Protection Policy and Programs (EH-52) issued Radiological Control Technical Position (RCTP) 99-02, *Acceptable Approach for Developing Air Concentration Values for Controlling Exposures to Tritiated Particulate Aerosols and Organically-Bound Tritium*.

RCTP 99-02 was limited to the assessment of dose and determination of air concentration values* (ACVs) for controlling exposures to tritiated particulate aerosols and organically-bound tritium. The RCTP did not discuss other radiological protection issues such as bioassay techniques, surface contamination monitoring, or air monitoring. The RCTP was to be used as interim guidance until such time that additional information concerning these issues was developed and appropriately reviewed, and DOE issued additional requirements and/or guidance.

Subsequent to the issuance of RCTP 99-02, EH-52 drafted technical standard OSCH-0002, *Radiological Control Programs for Special Tritium Compounds***. OSCH-0002 was prepared by DOE to assist the development and implementation of radiation protection programs to provide adequate protection against the hazards presented by special tritium compounds. Much of OSCH-0002 is based on work performed by the DOE contractor at the DOE Mound facility (currently BWXT of Ohio) and DOE funded research performed by the Lovelace Respiratory Research Institute.

**For regulatory purposes, the air concentration values for tritiated particulate aerosols and organically-bound tritium discussed in this RCTP were not defined as DAC values. DAC values are defined in appendix A to 10 CFR 835. However, the values discussed in RCTP 99-02 could be used in a similar manner as DAC values.*

*** At the time of issuance of this RCTP,OSCH-0002, "Radiological Control Programs for Special Tritium Compounds," is being finalized and will soon be available as a handbook. The draft or the final handbook is available from the DOE Technical Standards website:*

http://tis.eh.doe.gov/techstds/

This RCTP is intended to update the ACVs provided in RCTP 99-02 with the most up to

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date technical data. It will remain in effect until 10 CFR 835 can be amended to incorporate corresponding DAC values.

Discussion:

Applicable Requirements

10 CFR 835

Appendix A DERIVED AIR CONCENTRATIONS (DAC) FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES

The data presented in appendix A are to be used for controlling individual internal doses in accordance with § 835.209, identifying the need for air monitoring in accordance with § 835.403, and identifying and posting airborne radioactivity areas in accordance with § 835.603(d).

Radionuclide	Inhaled Air-Lung Retention Class uCi/ml			Inhaled Air-Lung Retention Class Bq/m^3			Stochastic or Organ
	D	W	Y	D	W	Y	(D/ W/ Y)
H-3 (Water)	2.E-05	2.E-05	2.E-05	8.E+05	8.E+05	8.E+05	St/St/St
H-3 (Elemental)	5.E-01	5.E-01	5.E-01	2.E+10	2.E+10	2.E+10	St/St/St

Technical Position:

RCTP 99-02 provided guidance on the assessment of dose and determination of ACVs for controlling exposures to special tritium compounds. The RCTP recognized that additional projects were under development, including evaluation of self-absorption of tritium beta particles in the metal particle and verifying that Bremsstrahlung production within particles is not a significant dosimetric factor.

OSCH-0002, *Radiological Control Programs for Special Tritium Compounds*, provides

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information that may be used as a technical basis for those programs that are developed and implemented to insure compliance with DOE's occupational radiation protection requirements.

Using the dose conversion factor from table 5-14 of OSCH-0002 for Type S hafnium tritide (i.e., the most restrictive) particulate aerosols results in the following ACV:

$$(0.05 \text{ Sv} / 4.3\text{E-}10 \text{ Sv/Bq}) / 2400 \text{ m}^3 = 4.\text{E+}04 \text{ Bq/m}^3 \qquad (1.\text{E-}06 \text{ uCi/ml})$$

The table provided in the summary of this technical position summarizes the ACVs for Type F, M, and S materials. The ACVs are based on observed activity (i.e, corrections are made for beta particle and energy self absorption and only radiation emitted from the tritide particle is considered).

ACVs for Type S and M particulates were derived by defaulting to a Type S hafnium tritide particle. Hafnium tritide had the most restrictive dose conversion factor listed in OSCH-0002. For Type S material, the default using hafnium tritide is slightly conservative compared to other materials. For Type M material, the default to Type S is even more conservative (by a factor of approximately 6). For material Type F, the DAC for H-3(water) is used. This is a slightly conservative default (by a factor of approximately 2).

Insoluble OBT in particulate form can be taken into the body by inhalation. OSCH-0002 treats components of oil as stable particulates when they become airborne droplets. An ACV value is then calculated using the above approach.

For soluble OBT, it is assumed that all activity deposited is instantaneously absorbed into the body. An ACV value is calculated using a dose conversion factor of 4.1E-11 Sv/Bq as discussed in section 5.2.5.1 of OSCH-0002.

Note that the ACVs are intended primarily for controlling workplace exposures. For dosimetry purposes, as pointed out in RCTP 99-02, it is permissible to use the latest biokinetic models based on the latest known physio-chemical properties of special tritium compounds.

The ACVs provided are stochastic values which, for all material types of tritium particulate aerosols, are more limiting than organ (i.e., non-stochastic) ACVs.

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Summary:

OSCH-0002 provides technical information that may be used as a technical basis for those programs that are developed and implemented to insure compliance with DOE's occupational radiation protection requirements. ACVs derived using the approach endorsed by OSCH-0002 (summarized in the following table) are acceptable for use when air concentration values are used to estimate internal dose under § 835.209(b). These values may also be used for identifying the need for air monitoring and identifying the need for posting.

The following table summarizes resultant ACVs (conservatively rounded) and provides comparison of these values to the DAC value for H-3 (water) given in appendix A to 10 CFR 835:

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AIR CONCENTRATION VALUES

Tritium Form/Type	uCi/ml	Bq/m^3	Ratio to H-3 (Water) DAC*
H-3 (Water)	2.E-05**	8.E+05**	1
H-3 (Elemental)	5.E-01**	2.E+10**	0.00004
Type F Tritium Particulate Aerosol	2.E-05	8.E+05	1
Type M Tritium Particulate Aerosol	1.E-06	4.E+04	20
Type S Tritium Particulate Aerosol	1.E-06	4.E+04	20
Organically-Bound Tritium (Insoluble)	1.E-06	6.E+04	13
Organically-Bound Tritium (Soluble)	9.E-06	3.E+05	2

* *This column is a ratio comparing H-3 (water) to the tritium form/type i.e., H-3 (water) DAC / tritium form/type air concentration value. Numbers greater than 1 indicate a more restrictive ratio than H-3 (water).*

** *These are the appendix A 10 CFR 835 DAC values.*

ACVs were derived using the lung model from Internationl Commission on Radiological Protection Publication 66. Values correspond to material Types F, M, and S rather than lung retention Classes D, W, and Y, respectively.

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References:

Title 10 CFR 835, *Occupational Radiation Protection*, U.S. Department of Energy, November 4, 1998

Radiological Control Technical Position 99 - 02, *Acceptable Approach for Developing Air Concentration Values for Controlling Exposures to Tritiated Particulate Aerosols and Organically-Bound Tritium*

OSCH-0002, *Radiological Control Programs for Special Tritium Compounds* (draft), March 2001.